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An Assessment of Ground Level and Free Tropospheric Ozone Over California and Nevada

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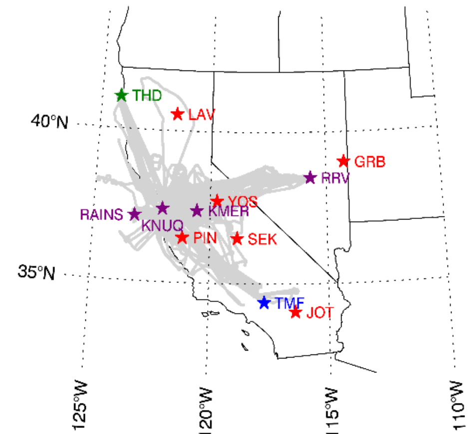
Key Points:

- Modeling results suggest that 2012 elevated O_3 at surface sites is associated with increased exposure to upper troposphere and lower stratosphere
- In spring 72% and summer 65% of O_3 vertical profiles have elevated O_3 lamina (3-8 km, O_3 > 70 ppb)
- Observational analysis highlights importance of both surface O_3 and O_3 aloft in understanding the varying sources of O_3 in the western U.S.



This observation-based analysis of vertical ozone from:

Alpha Jet Atmospheric eXperiment (AJAX),

ozonesonde (THD) and

ozone lidar (TMF), plus

ground-based ozone from US EPA CASTNET sites

provides useful insight into the sources of elevated surface O_3 in the rural western US.

To track individual sources of ozone, global tagged tracer simulations of GEOS-Chem were also conducted.

Yates, et al. (2017). An assessment of ground level and free tropospheric ozone over California and Nevada. J. Geophys. Res., 122, 10,089–10,102, https://doi.org/10.1002/2016JD026266

Correlation analysis between AJAX ozone and CASTNET surface sites

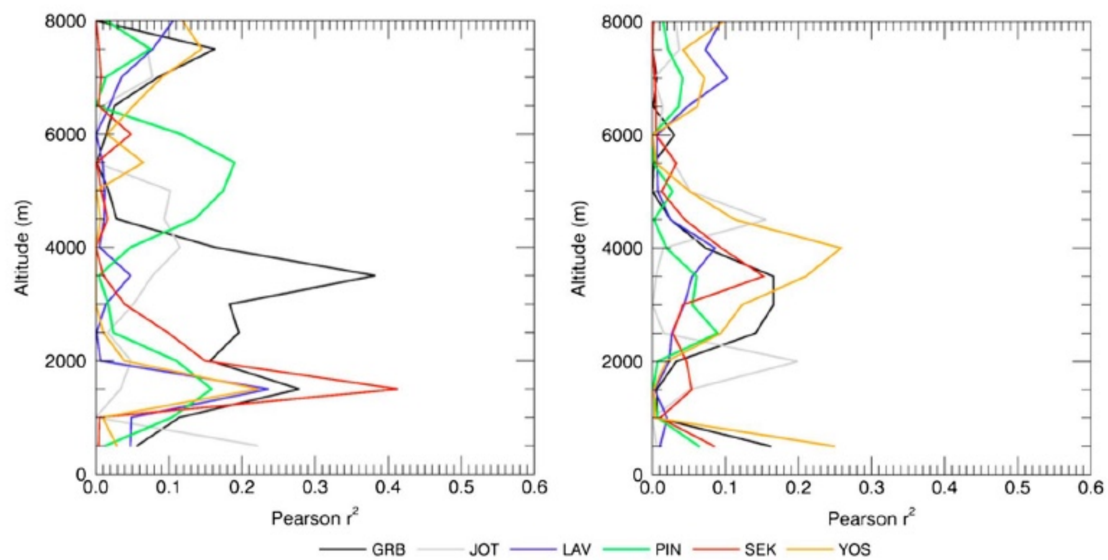
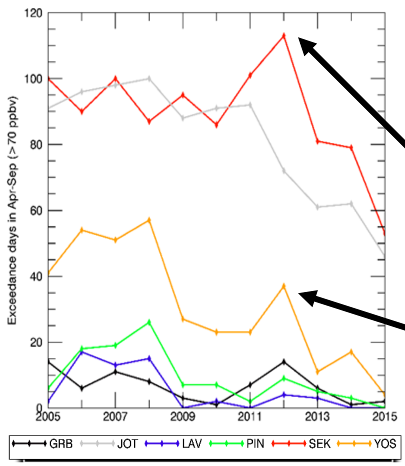


Figure 8. Correlation coefficients of mean AJAX O_3 with seasonally corrected surface O_3 measured at Great Basin (GRB, black), Joshua Tree (JOT, gray), Lassen Volcanic (LAV, blue), Pinnacles (PIN, green), Sequoia (SEK, red), and Yosemite (YOS, orange) National Parks in spring (April–May, left) and summer (June–September, right) 2010–2014.

The correlation (r2) was calculated between seasonally corrected surface O3 and the mean regional O3, averaged in 500 m vertical layers over the entire AJAX flight.

- “Seasonally Corrected”: 29-day average value at the mean time of a single AJAX flight was subtracted from the surface-measured hourly O3, and the difference (surface O3 minus estimated seasonal O3) was used in the correlation analysis.

Correlations between AJAX observations aloft and surface O3 are larger in spring than in summer months and are weaker still in winter/fall (not shown). Enhanced correlations suggest there are common influences that impact O3 at CASTNET surface sites and O3 aloft.



Number of exceedance days
April – Sept (MDA8 > 70 ppb)

- **72% of Spring and 65% of Summer vertical profiles have elevated ozone laminae** (O_3 >70 ppb between 3-8 km).
- Reduction of US NAAQS from 75 ppb to 70 ppb O_3 **combined with increasing baseline O_3 impacts the attainment status of O_3 surface sites**, increasing exceedances primarily in summer.
- GEOS Chem analysis shows **2012 increase in exceedance days was primarily due to <u>increased UTLS exposure</u>**, highlighting the influence of air aloft on surface O_3 values in the western US.

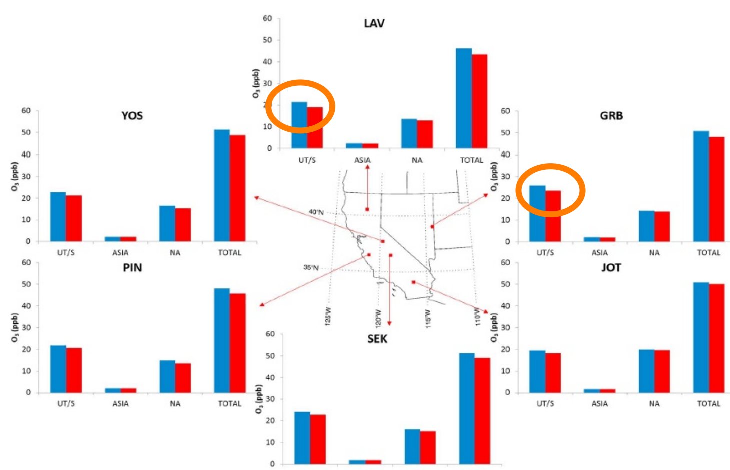


Figure 3. Results from GEOS-Chem tagged O_3 tracer simulation at the location of CASTNET stations evaluated during this study (Great Basin (GRB), Joshua Tree (JOT), Lassen Volcanic (LAV), Pinnacles (PIN), Sequoia (SEK), and Yosemite (YOS) National Parks). The daytime-averaged (ppb) surface mixing ratios between May and September from the main O_3 sources: UT/S (Upper Troposphere and Stratosphere), ASIA (boundary layer), and NA (North America boundary layer) and total O_3 during 2012 (blue bars) and 2013 (red bars).